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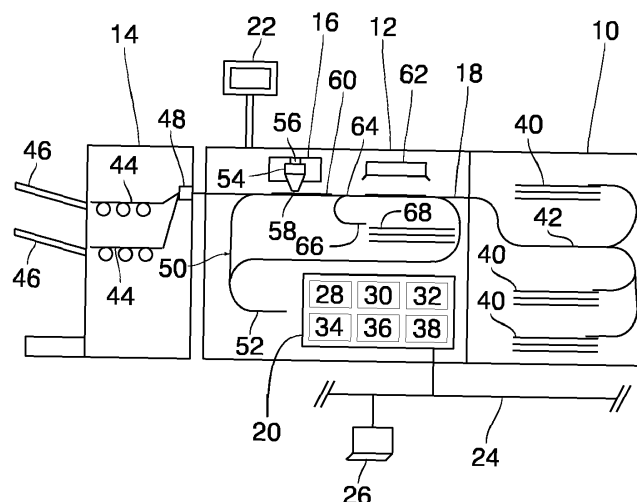
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(54) **METHOD OF MONITORING A SHEET SUPPLY SYSTEM**

(57) A sheet printer may comprise a sheet quality detection device and a discharge system arranged to divert rejected sheets into a discharge path (66). When a majority of sheets in the sheet stack in a first input tray (40) are unsuited for printing, the discharge system will discharge said majority of sheets. As most sheets in said input tray are unsuitable, the print productivity is reduced. The present invention prevents this by tracking the

number of rejected sheet per input tray. This number is compared to a threshold, and when said threshold has been exceeded, the printer's controller (38) generates an error signal. The error signal is configured to initialize a desired corrective action, such as preventing further sheet feeding from the first input tray, informing an operator, or switching to a different input tray with the same media type as the first input tray.

Fig. 1



Description

[0001] The invention relates to a method of monitoring a sheet supply system in a printer comprising: at least two input trays; a print station; the sheet supply system arranged to feed sheets from said at least two input trays to the print station; a sheet quality detection device (herein further referred to as a sentry) disposed at the sheet supply system upstream of the print station for checking a quality of the sheets and rejecting defective sheets; and a discharge system arranged to divert rejected sheets into a discharge path.

[0002] A printer to which the invention is applicable has been disclosed in WO 2016/177676 A1. In this printer, when the sentry finds that a sheet is damaged, meaning for example that the sheet is warped or wrinkled to such an extent that the print quality would be compromised or the sheet would collide with a print head in the print station, the defective sheet is discarded and the allocation of images to be printed to the subsequent sheets is re-scheduled such that the print order is preserved. In this way, it can in many cases be avoided that the print process must be aborted.

[0003] US 2015077786 A1 describes a printing system wherein an image forming unit is selected from among a plurality of image forming units on the basis of detected defect rates of the units.

[0004] It is an object of the invention to improve a print process performed with a printer of the type indicated above.

[0005] In order to achieve this object, the method according to the invention is characterized by the following steps which are performed separately for each input tray:

- (a) determining a number D of defective sheets supplied from a first one of the at least two input trays;
- (b) comparing the number D to a predetermined threshold T; and
- (c) issuing an error signal when the number D exceeds the predetermined threshold T.

[0006] The invention is based on the consideration that, when defective sheets occur, the defects will in many cases be due to some malfunction in the part of the sheet supply system that withdraws the sheets from a stack in the input tray. Other typical causes for defective sheets are that the stack of sheets has not been loaded properly into the input tray or the package that has contained the stack of sheets has become damaged already during transport. In all these cases it is likely that many or even all sheets that originate from the same input tray will be defective. Thus, if the print process is continued with feeding sheets from the same tray, it can be anticipated that the productivity of the print process will be low and/or the print process will have to be aborted because the capacity of a discharge bin for collecting the rejected sheets is exhausted.

[0007] In the method according to the invention, these

negative consequences can be avoided by monitoring the relative number of defective sheets for each input tray and, when that relative number justifies the assumption that more defects will occur, issuing an error signal which may trigger any suitable countermeasure with the purpose to reduce the number of defective sheets being fed to the print station.

[0008] More specific optional features of the invention are indicated in the dependent claims.

[0009] In an embodiment, the step of determining a number of defective sheets comprises determining said number per predetermined period or unit time supplied from the first one of the at least two input trays. The number of rejected sheet is compared to a predefined time period. This period e.g. starts when initializing a print job and may have any suitable duration. The predetermined period may vary per print job dependent on print speed, media type, etc. Similarly, the controller may apply the number of rejected sheets per unit time, e.g. the number of rejected sheets per second, minute, etc. It will be appreciated that the present invention encompasses any mathematical or logical operation of the number of rejected sheets and/or its comparison to the predetermined threshold. The number of rejected sheets may for example be integrated over time, differentiated, etc., to improve the accuracy. It will further be appreciated that the term exceeding is herein preferably applied as the number of rejected sheets crossing or passing the threshold in either an up or down direction. The error signal is e.g. triggered when the absolute difference between the number of sheets and the threshold approaches a zero value.

[0010] In a preferred embodiment, the error signal comprises a command to prevent further feeding of sheets from the first one of the at least two input trays. The method according to the present invention preferably further comprises the step of preventing further feeding of sheets from the first one of the at least two input trays when the number exceeds the predetermined threshold. When a first input tray is determined to be unsuitable for further sheet feeding, the controller of the printer stops the sheet feeding mechanism of the first input tray. No more sheets are then fed from the first input tray to the print station. Subsequent sheets are then supplied from one or more different input trays other than the first one of the input trays.

[0011] In another embodiment, the method according to the present invention further comprises the step of selecting the first one of the at least two input trays based on a media requirement of a print job. The print job information input to the user interface comprises a media requirement prescribing a media type to be used for said print job. The controller stores a media catalogue, which allows the controller to determine which input tray or trays hold suitable sheets. The controller thereby determines which input trays meet the media requirement. From these input trays loaded with the same media type of sheets, the controller selects a first input tray to begin

feeding sheets to the print station. Further sheets may be fed from the same input tray or from different input trays with the same media type. For each input tray being used for feeding sheets, the controller tracks the number of rejected sheets which originated from said input tray or trays. The controller is thus configured to determine from which input tray a rejected sheet originated. For each input tray a threshold or maximum sheet rejection number has been defined by the controller. During operation, the controller then compares per used input tray the number of rejected sheets to the respective threshold. When the number of rejected sheets of an input tray exceeds its corresponding threshold, the controller generates the error signal. The error signal then prompts a corrective action, preferably preventing further sheet feeding from said input tray.

[0012] In another embodiment, the error signal triggers the step of switching to another one of the at least two input trays to feed sheets to the print station. When the number of rejected sheets of a first input tray exceeds its threshold, the controller determines or designates said input tray as unsuitable for further sheet feeding. To continue sheet feeding, the controller then switches to a second input tray different from the first. Subsequently, the controller ensures sheets are fed from the second input tray, but prevents sheet feeding from the first input tray. Sheet feeding from the first input tray is temporarily halted until the first input tray is cleared for sheet feeding. This clearing may be done by the operator, e.g. after inspection of the input tray. In a preferred embodiment, the method according to the present invention further comprises the step of switching to the other one of the at least two input trays to feed sheets to the print station.

[0013] In another embodiment, the method according to the present invention further comprises the step of searching for another one of the at least two input tray containing sheets of the same media type as the sheets in the first input tray for which the threshold value has been exceeded. When a first input tray is determined to be unsuitable for sheet feeding, the controller consults the media catalogue to determine the media types in the remaining input trays. If a media type of a further input tray matches the media type of the first input tray, the controller selects said second tray for further sheet feeding to the print station.

[0014] In a further embodiment, the error signal is a signal alerting a user or operator. The error signal is preferably a digital signal comprises data identifying the first one of the input trays. The data may further contain data regarding the number of rejected sheets.

[0015] In another embodiment, the error signal includes a command to interrupt the printer. In case no alternative input trays are available, the print operation is halted. Printing may then resume upon filling an input tray with the required media type.

[0016] In an exemplary embodiment, the method further comprises the steps:

- (a) counting a total number N of sheets supplied from the tray;
- (b) counting a number D of defective sheets supplied from the tray;
- (c) calculating the quotient D/N ; and
- (d) issuing an error signal when the quotient D/N exceeds a predetermined threshold.

[0017] In the simplest case, the error signal may be used for triggering an alarm that will alert a user or operator who will then load another stack of non-defective sheets into another input tray of the printer and switch to the other input tray. The operator may further remove the sheets from the former tray and check whether or not these sheets are defective. If not, it is likely that the reason for the defects has to do with a malfunction of the part of the sheet supply system that is associated with that tray, and the operator will preliminarily block this tray until the malfunction can be remedied.

[0018] The alert may be displayed on a monitor of a user interface of the printer, preferably accompanied by an acoustic alarm. In a useful embodiment, the alert may also be sent to a mobile phone or a mobile device of the user or operator, so that the operator can be alerted even if she is not present at the printer.

[0019] In another embodiment, the method may also comprise a step of automatically switching to another input tray, provided that there is another input tray that contains media sheets of the required type.

[0020] In another aspect, the present invention pertains to a printer comprising:

- a sheet supply system comprising at least two input trays;
- a print station, the sheet supply system arranged to feed sheets from said at least two input trays to the print station;
- a sheet quality detection device disposed at the sheet supply system upstream of the print station for checking a quality of the sheets and rejecting defective sheets;
- a discharge system arranged to divert rejected sheets into a discharge path;
- a controller configured for:

(a) determining a number of defective sheets supplied from a first one of the at least two input trays;

(b) comparing the number to a predetermined threshold; and

(c) issuing an error signal when the number exceeds the predetermined threshold. As explained above, the controller generates the error signal when the number of rejected sheets for an input tray exceeds the corresponding threshold.

[0021] Preferably, the controller is configured to pre-

vent feeding of further sheets from the first one of the at least two input trays when the number exceeds the predetermined threshold. The controller then halts or pauses the feeding of the first one of the input trays. Said first input tray or its sheet separation and feeding mechanism is thereby de-activated.

[0022] In an embodiment, the controller is further configured for selecting the first one of the at least two input trays based on a media requirement of a print job. When the first input tray is disabled or de-activated, the controller is then configured to select a second input tray meeting the media requirement. The second preferably holds the same media type as the first input tray. Further sheet feeding is then done from the second input tray.

[0023] In a further embodiment, the controller is further configured for switching to another one of the at least two input trays to feed sheets to the print station when the number exceeds the predetermined threshold. The controller is configured to select a second one of the at least two input trays, preferably with a media type similar to the first one of the at least two input trays. In a preferred embodiment, the controller is further configured for:

- searching for another one of the at least two input trays containing sheets of the same media type as the sheets in the first input tray for which the predetermined threshold has been exceeded; and
- switching to another one of the at least two input trays with said same media type to feed sheets to the print station when the number exceeds the predetermined threshold.

[0024] Embodiment examples will now be described in conjunction with the drawings, wherein:

- Fig. 1 is a schematic view of a printing system to which the invention is applicable;
- Figs. 2 and 3 show screen images to be displayed on a user interface of the printer in conjunction with the method according to the invention; and
- Fig. 4 a flow diagram illustrating essential steps of a method according to the invention.

As is shown in Fig. 1, a printer that is described here as a representative example comprises an input section 10, a main body 12, and an output section 14. The main body 12 comprises a print station 16, a sheet supply system including a sheet transport path 18, an electronic controller 20 and a user interface 22.

[0025] The controller 20 may be formed by a computer, a server or a workstation and is connected to all the functional components of the printer for controlling the same and is further connected to the user interface 22 and to a network 24 via which the controller may communicate

with a remote workstation 26 of a user or operator. In an alternative embodiment, the controller 20 may also be installed outside of the main body 12 for controlling the various system components via the network 24.

[0026] The hardware and/or the software of the controller 20 includes among others a print job receiving section 28, a scheduler 30, a feed control section 32, a print control section 34, an output control section 36, and a sheet manager 38. The print job receiving section 28 is arranged to receive, e.g. via the network 24, print jobs each of which includes image data for one or more pages to be printed as well as various job settings. Optionally, the image data may also be received from a local scanner whereas the job settings are input at the user interface 22. The job settings include among others instructions that specify for each image to be printed the properties or type of a recording medium on which the image shall be printed.

[0027] The input section 10 includes a plurality of holders 40 each of which accommodates a supply, e.g. a stack, of media sheets of a certain media type. The media types in the different holders 40 may differ in sheet thickness, sheet material, surface properties of the sheets and the like. The input section 10 further includes a feed mechanism 42 arranged to separate individual sheets from a selected one of the holders 40 and to supply them one by one into the sheet transport path 18 under the control of the feed control section 32.

[0028] When the job receiving section 28 has received a print job, the scheduler 30 determines a sequence in which the images of this print job shall be printed. The scheduler 30 further has access to a database that stores the media types and properties of the sheets accommodated in the various holders 40. Based on the job settings that concern the media properties, the scheduler 30 selects the holders 40 from which the sheets with the desired properties are to be taken and determines a sequence in which the sheets of the different media types are to be fed into the sheet transport path 18 such that the sequence of sheets matches the sequence of images to be printed.

[0029] When the print process has been started, the feed control section 32 controls the feed mechanism 42 to supply the sheets in the sequence as scheduled into the sheet transport path 18, and the print control section 34 controls the print station 16 so as to print a corresponding image on the top side of each sheet.

[0030] In the example shown, the output section 14 has a plurality of holders 44 on which the sheets may be stacked after they have left the print station 16. When a stack, which may for example comprise a set of sheets forming a complete copy of a multi-page document, has been completed, the holder 44 will forward the stack onto an associated output tray 46. In an alternative embodiment the completed stacks may also be forwarded to a finisher (not shown) for performing finishing operation such as stapling, punching and the like.

[0031] The output section 14 further includes a switch

48 which is controlled by the output control section 36 for directing each sheet to a designated one of the holders 44.

[0032] The main body 12 of the printing section includes a duplex path 50 which branches off from the sheet transport path 18 downstream of the print station 16, reverses the orientation of the sheets in a sheet reversing mechanism 52 and then returns the sheets upside down to the entry side of the sheet transport path 18.

[0033] It shall further be assumed in this example that the print station 16 includes as print engine an ink jet print head 54 that is disposed above the sheet transport path 18 and is adjustable in height by means of a height adjustment mechanism 56. Dependent upon the thickness and other properties of the sheets, the height of the print head 54 is adjusted such that a nozzle face 58 at the bottom side of the print head forms only a very narrow gap with a top surface of a sheet 60 that is being conveyed past the print head. In this way, it will be assured that, for each individual sheet, the ink jet print process will be performed with an optimal nozzle-to-sheet distance.

[0034] As the gap between the nozzle face 58 and the sheet 60 may be very small, any wrinkles or a surface waviness or other surface irregularities of the sheet 60 may result in a poor image quality or even in a collision of the sheet with the print head. For this reason, a sentry 62 for monitoring the quality of the sheets is disposed at the sheet transport path 18 upstream of the print station 16. The sentry 62 may for example be a 3D laser scanner that scans the entire surface of the sheet in order to capture a surface relief. An example is described in US 2016103634 A1. The relief data are transmitted to the sheet manager 38 in the controller 20, where they are processed further to decide whether the quality of the sheet is acceptable or not. In this specification, a sheet will be designated as "damaged" if the quality detected by the sensor 62 is not acceptable. The sensor 62 may also detect other quality criteria relating to, for example, alignment errors or skew errors of the sheets.

[0035] When a sheet is found to be damaged, the sheet manager 38 controls a switch 64 in the sheet transport path 18 in order to excise this sheet from the scheduled sequence and to divert it into a discharge path 66 via which the sheet is discharged into a discharge bin 68. In this way, the defective sheet will be skipped in the print process. However, the image that was designated for being printed onto the discarded sheet must nevertheless be printed. In duplex printing this may have the consequence that all the sheets that had been present already duplex path 50 have to be discarded as well, even if they are not damaged, because the wear the wrong image on their first side.

[0036] It should be observed in this context that Fig. 1 is only a schematic sketch and that, in practice, the number of sheets that can be accommodated in the duplex path 50 can be considerably large. For example, the duplex path 50 may be arranged to accommodate as many as 40 sheets.

[0037] As is shown in Fig. 2, the sheet manager 38 keeps a log of all events where a sheet has been rejected by the sentry 62. For each event, the log stores the cause of the event, i.e. the kind of defect that has led to the rejection of the sheet, the origin of the sheet, i.e. the input tray from which it was fed, the media type loaded in that tray, a job ID identifying the print job in which the event had occurred, as well as the time of the event. The log shown in Fig. 2 may be displayed on a screen of the user interface 22 upon a command of the user or operator.

[0038] Based on the log data, the sheet manager 38 keeps separate records for all input trays 40 of the printer. These records may also be displayed on the user interface, as has been illustrated in Fig. 3. Each input tray is designated by a number (1-4), a symbol indicating the fill state of the tray, an identification of the media type (e.g. "80 g A4"), a threshold value T, a total number N of sheets that have been fed from the pertinent tray since the last refill of the tray; a number D of defective sheets that have been supplied from that tray and have been rejected by the sentry 62, and the quotient D/N. If the quotient D/N is larger than the threshold value T for a particular tray, as in case of tray No. 2 in the example shown in Fig. 3, then the sheet controller 38 generates an error signal which indicates that something is wrong with the tray and the tray should be blocked. In Fig. 3, this has been indicated by crossing-out the symbol and the number of the tray. In this way, the operator can see that he has to look after tray No. 2. Preferably, the error signal is accompanied by an acoustic alarm alerting the operator. The error signal and preferably the entire screen image shown in Fig. 3 may also be sent to the workstation 26 via the network 24. Optionally, the controller 20 may also be connected to a mobile network, so that the error message can be sent to mobile devices of the users and the operator.

[0039] Depending upon the physical properties of the media sheets, each media type will have a specific natural defect rate which should be tolerated without alerting the operator. The threshold value T is selected to be slightly larger than the natural defect rate. To that end, although not shown in the drawings, the controller 20 stores an editable list which assigns a threshold value to each media type that may be loaded into one of the trays 40 of the printer. In the records shown in Fig. 3, the sheet manager stores information on the media type of the sheets that are presently loaded in the different trays 40 of the printer, and on the basis of this information the sheet manager retrieves the pertinent threshold values T from the editable list.

[0040] An embodiment of the method according to the invention will now be explained in conjunction with the flow diagram shown in Fig. 4.

[0041] A software routine embodying the method according to the invention starts with a step S1 when an input tray 40 has been selected for feeding the sheets to the print station 16. In step S2, the media type of the sheets loaded in that tray is read from the records stored

in the sheet manager (Fig. 3), and the related threshold value T is read in step S3.

[0042] A step S4 consists of counting the total number N of sheets that have been fed from the selected tray to the print station. More specifically, the value of the count N is initialized to 0 in step S1 and is incremented by 1 in step S4 whenever another sheet is fed to the sentry 62. If the sheet has no defects, it is passed-on to the print station 16. If a defect is detected, the sentry rejects the sheet and commands the sheet manager to divert the sheet into the discharge bin 68. In that event, the instantaneous value of the number D of rejected sheets, which was also initialized to 0 in step S1, is incremented by 1 in step S5.

[0043] Whenever the count D has been incremented, it is checked in step S6 whether the quotient D/N is larger than the threshold value T. As long as the threshold is not exceeded (N), the print process is continued and the steps S4 to S6 are repeated.

[0044] As soon as the threshold value T is exceeded in step S6, an error signal (alert) is issued in step S7.

[0045] In the example shown here, this error signal causes the sheet manager 38 to search, in step S8, for another tray in which sheets of the same media type have been loaded. Then it is checked in step S9 whether a suitable tray has been found. If this is the case (Y), the sheet manager switches to that other tray in step S10, so that the further sheets will be supplied from that tray. In the example shown in Fig. 3, the sheet manager would switch to tray No. 1 which contains the same media type (80 g A4).

[0046] If no suitable tray is found in step S9 (N), it is checked in step S11 whether the storage capacity of the discharge bin 68 becomes exhausted. In that case (Y), the print process is aborted in step S12.

[0047] In this specific example, if it is found in step S11 that no overflow of the discharge bin needs to be feared (N), the print process is continued and the step S11 is repeated until the operator loads new sheets of the required type into one of the trays. This strategy may be appropriate in case of simplex printing.

[0048] In case of a duplex print process it may however be preferred to skip the step S11 and to interrupt the printer immediately when it has been found in step S9 that no suitable other tray is available. In this way, it is possible to avoid a large amount of waste which would result from the fact that not only the defective sheet would have to be discarded but also all the other sheets in the duplex loop which carry already an image on one side. This reduces not only the waste of media sheets but also the waste of marking material (ink).

Claims

1. A method of monitoring a sheet supply system (18, 38, 42) in a printer comprising:

at least two input trays (40), a print station (16), the sheet supply system arranged to feed sheets (60) from said at least two input trays (40) to the print station (16), a sheet quality detection device (62) disposed at the sheet supply system upstream of the print station (16) for checking a quality of the sheets and rejecting defective sheets, and a discharge system (64) arranged to divert rejected sheets into a discharge path (66), the method being **characterized by** the following steps:

- (a) determining a number (D) of defective sheets supplied from a first one of the at least two input trays (40);
- (b) comparing the number (D) to a predetermined threshold; and
- (c) issuing an error signal when the number (D) exceeds the predetermined threshold.

2. The method according to claim 1, wherein the error signal comprises a command to prevent further feeding of sheets from the first one of the at least two input trays (40).
3. The method according to any of the previous claims, wherein the error signal triggers the step of switching to another one of the at least two input trays (40) to feed sheets to the print station (16).
4. The method according to claim 3, further comprising the step of switching to the other one of the at least two input trays (40) to feed sheets to the print station (16).
5. The method according to claim 3 or 4, further comprising the step of searching for another one of the at least two input tray (40) containing sheets of the same media type as the sheets in the first input tray (40) for which the threshold value has been exceeded.
6. The method according to any of the previous claims, wherein the error signal is a signal alerting a user or operator.
7. The method according to any of the previous claims, wherein the error signal includes information identifying the input tray (40) for which the threshold has been exceeded.
8. The method according to any of the preceding claims, wherein the error signal includes a command to interrupt the printer.
9. The method according to claim 8, wherein it is decided, dependent upon a print mode, simplex or duplex, whether or not the error signal includes the

command to interrupt the printer.

10. The method according to any of the preceding claims, comprising the step of assigning a threshold value (T) to each media type of sheets that may be loaded in the printer, and storing the media types and the associated threshold values in an electronic file. 5

11. A software product comprising program code on a computer-readable, non-transitory medium, the program code, when loaded into a controller (20) of a printer according to the preamble of claim 1, causes the controller (20) to perform the method according to any of the preceding claims. 10
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12. A printer comprising:
 - a sheet supply system (18, 38, 42) comprising at least two input trays (40); 20
 - a print station (16), the sheet supply system arranged to feed sheets (60) from said at least two input trays (40) to the print station (16);
 - a sheet quality detection device (62) disposed at the sheet supply system upstream of the print station (16) for checking a quality of the sheets and rejecting defective sheets; 25
 - a discharge system (64) arranged to divert rejected sheets into a discharge path (66);
 - a controller (20) configured for: 30
 - (a) determining a number (D) of defective sheets supplied from a first one of the at least two input trays (40);
 - (b) comparing the number (D) to a predetermined threshold; and 35
 - (c) issuing an error signal when the number (D) exceeds the predetermined threshold.

13. The printer according to claim 12, wherein the controller (20) is further configured for selecting the first one of the at least two input trays (40) based on a media requirement of a print job. 40

14. The printer according to claim 12 or 13, wherein the controller (20) is further configured for switching to another one of the at least two input trays (40) to feed sheets to the print station (16) when the number (D) exceeds the predetermined threshold. 45
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15. The printer according to claim 14, wherein the controller (20) is further configured for:
 - searching for another one of the at least two input trays (40) containing sheets of the same media type as the sheets in the first input tray (40) for which the predetermined threshold has been exceeded; and 55

- switching to another one of the at least two input trays (40) with said same media type to feed sheets to the print station (16) when the number (D) exceeds the predetermined threshold.

Fig. 1

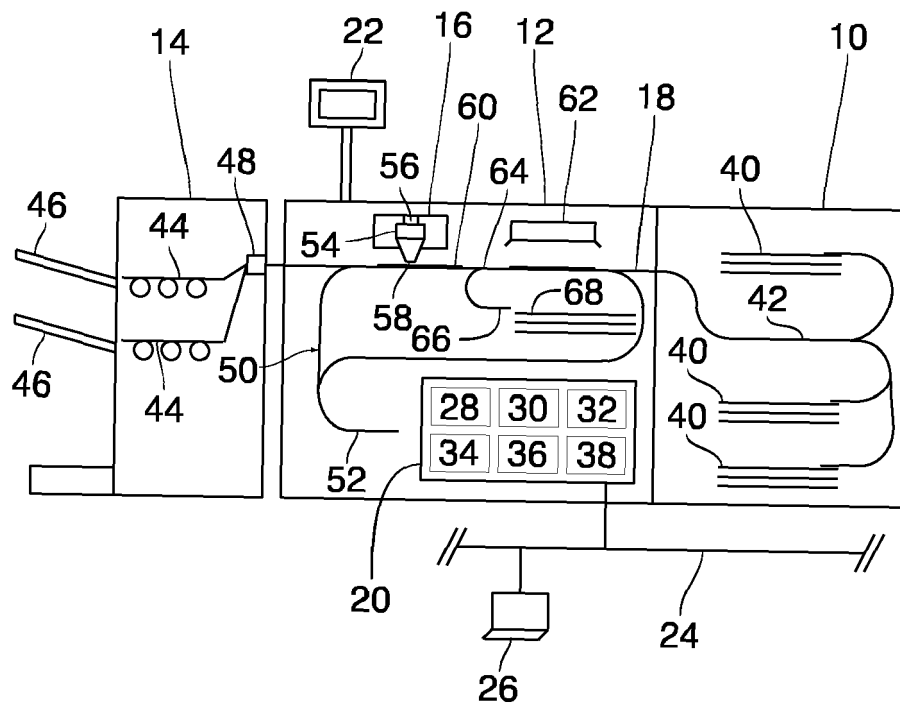


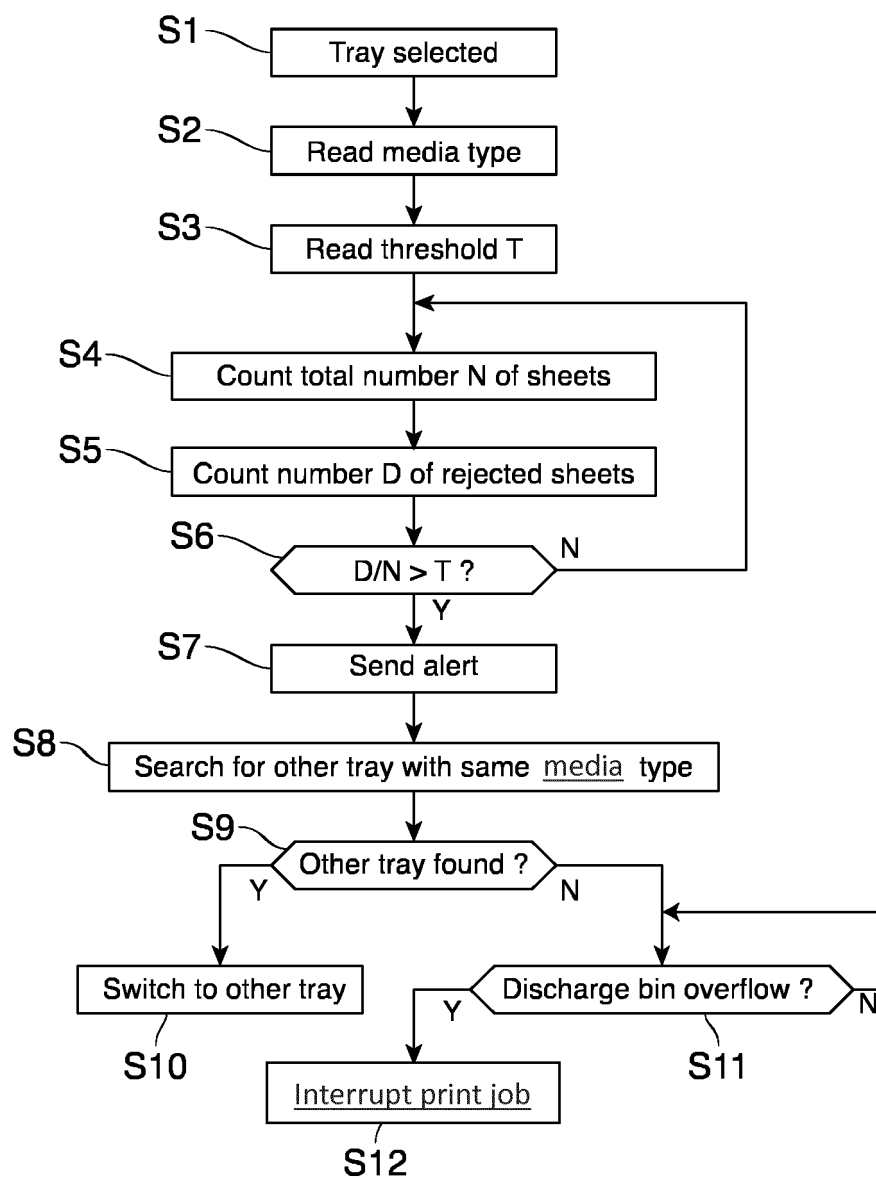
Fig. 2

#	Cause	Origin	Media	Job ID	Time

Fig. 3

Trays				T	N	D	D/N
1		80 g	A4	0.2	855	7	0.008
2		80 g	A4	0.2	220	45	0.205
3		120 g	A4	0.1	0		
4		80 g	A3	0.3	0		

Fig. 4





EUROPEAN SEARCH REPORT

Application Number
EP 18 19 1719

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	WO 2016/177676 A1 (OCE-TECHNOLOGIES B V [NL]) 10 November 2016 (2016-11-10) * page 6, line 17 - line 32; figure 1 * -----	1-15	INV. B41J11/00 B41J13/00 B41J3/60 B41J11/48
			TECHNICAL FIELDS SEARCHED (IPC)
			B41J G03G
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 1 February 2019	Examiner Wehr, Wolfhard
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EPO FORM 1503 03.02 (P04C01)

01-02-2019

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REFERENCES CITED IN THE DESCRIPTION

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